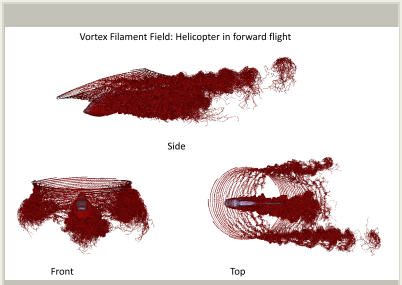
Analysis of Active Flow Control Concepts Using the 3D LES VorCat Software, Phase I

Completed Technology Project (2016 - 2016)

Project Introduction

The goal of this project is to produce a revolutionary computational methodology that is fast, reliable and accurate for predicting complex high Reynolds number, turbulent flows associated with efficient aerodynamic designs. The proposed work will focus on low-speed canonical flows that introduce challenging physics, e.g., separation, transition and turbulence onset/progression, vortex/viscous interactions, merging shear layers with strong curvature, juncture flows, etc.. The extension of our proposed methodology to compressible flows has already begun and will be pursued in Phase II and beyond. The VorCat implementation of the gridfree vortex method is particularly attractive in this case since it efficiently represents near-wall vorticity producing motions while at the same time capturing the dynamics of the shed vorticity without numerical diffusion. An accurate and well resolved accounting of the boundary flow is crucial for controlling separation and other complex phenomena while unsteady free vortices are responsible for producing sound, downstream wing/vortex interactions and a range of other important phenomena. A number of previous published studies have established the unique benefits and accuracy of the VorCat vortex filament method. These include computations of ground vehicle flows, isotropic turbulence, shear layers, coflowing round jets, and boundary layers. Additional validation studies have been conducted in such applied settings as wind turbines, rotorcraft and particulate flows. Collectively, these results establish the effectiveness of the vortex filament scheme in capturing the flow structure and statistics for complex flow fields in a way that has not been duplicated by alternative grid-based methodologies. In the realm of vortex structure the VorCat approach has opened up a window into the dynamics of flow organization that is forcing a reassessment of some of the principal ideas concerning the physics of turbulent flow (J. Phys., 2011).



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Small Business Innovation Research/Small Business Tech Transfer

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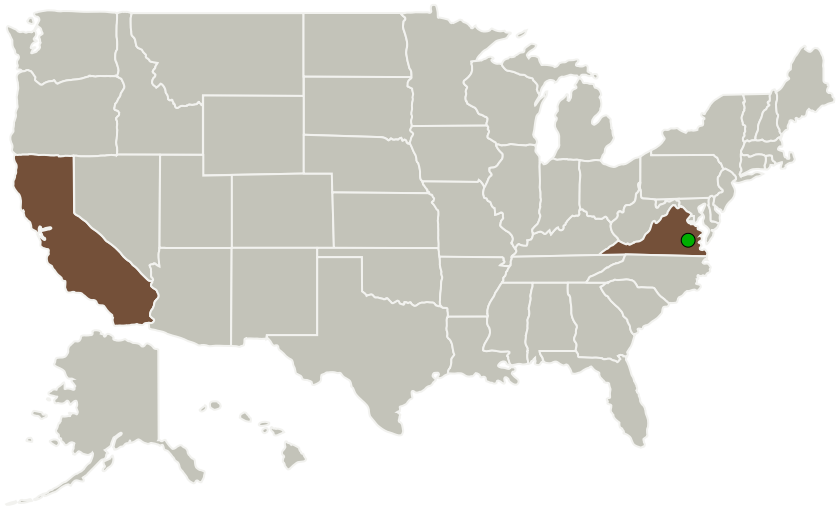
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
VorCat, Inc.	Lead Organization	Industry	Rockville, Maryland
Langley Research Center(LaRC)	Supporting Organization	NASA Center	Hampton, Virginia

Primary U.S. Work Locations	
California	Virginia

Project Transitions

June 2016: Project Start

December 2016: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/139741)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

VorCat, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

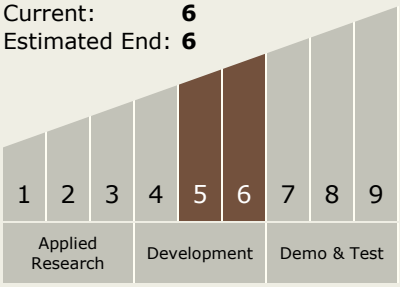
Carlos Torrez

Principal Investigator:

Jacob Krispin

Technology Maturity (TRL)

Start: **5**
Current: **6**
Estimated End: **6**



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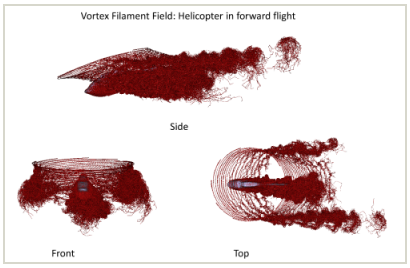
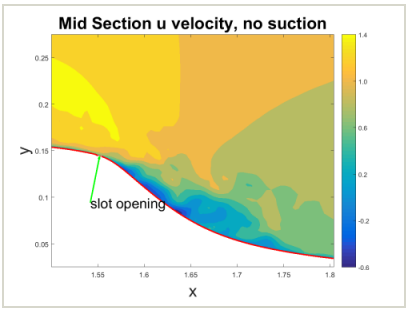
Images



Briefing Chart Image
Analysis of active flow control concepts Using the 3D LES VorCat Software, Phase I
(https://techport.nasa.gov/image/133141)



Final Summary Chart Image
Analysis of active flow control concepts Using the 3D LES VorCat Software, Phase I Project Image
(https://techport.nasa.gov/image/134712)

Technology Areas

Primary:

- TX15 Flight Vehicle Systems
  - TX15.1 Aerosciences
    - TX15.1.1 Aerodynamics

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System